REMARKS/ARGUMENTS

The Official Action dated 02 November 2005 has been carefully considered, along with cited references, applicable sections of the Patent Act, Patent Rules, the Manual of Patent Examining Procedure and relevant decisional law.

Claim 1 is objected to because of the following informalities: recitation of "input time of the input signals" in lines 7-8 is not clear.

In response, claim 1 has been amended to clearly define the invention.

Claims 1 and 4-6 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Poe et al. (US 6,646,847).

Claims 2 and 3 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Poe et al. (US 6,646,847) in view of Sasahara et al. (US 5,856,756).

Claims 7-11 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Gonthier et al. (US 2004/0066594 A1).

Claims 12-14 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Gonthier et al. (US 2004/0066594 A1) in view of Fukaya et al. (4,287,390).

In response, the subject matters of claims 12-14 have been cancelled, so that it is unnecessary to discuss the grounds of rejection specific thereto.

Applicant respectfully submits that the present invention is significantly different from that of the cited arts as can be seen from their respective structures. Applicant's invention as specified in the amended claims 1, 3, and 5-11 is patentably distinguishable

over these references when taken either singularly or in combination for the following reasons:

The Examiner cites, for claim 1, Poe et al. as an example of a short circuit detecting and protecting circuit comprising a switching unit 112, G1 for obtaining input signals, a comparator 104, U1 including a first input terminal coupled to said switching unit, an output terminal, and a second input terminal, and including an internal voltage, means for detecting a voltage difference (see R-SENSE in Figure 2 and 3) between said first and said second input terminal of said comparator, said comparator comparing the voltage difference between said first and said second input terminal of said comparator and internal voltage of said comparator, to determine a short-circuit or overload situation.

However, the Examiner has noted that Poe et al. does not disclose a control transistor coupled between said switching unit and said second input terminal of said comparator,

Actually, in Poe et al., as shown in Figure 2, R-SENSE is coupled in series with R_LOAD, such that all the current flowing through R_LOAD has to go through R-SENSE; i.e., R-SENSE consumes some portion of the electric power when R_LOAD is being driven. It is to be noted that the circuit of Poe et al. is provided for power devices such that we need to detect any abnormal current, and such that both R_LOAD and R-SENSE are required to be made small.

As disclosed in col. 3, lines 20-22, R_LOAD is 12 ohms and R-SENSE is 0.33 ohms, ignoring R_LIMIT of 20 ohms in series, the power loss is around 2.7%. The power loss may be made

smaller if R-SENSE is made smaller. However, R-SENSE may not be made too small due to process variation and difficulty of detecting a small voltage across a small R-SENSE in an integrated circuit.

By contrast, in Applicant's invention, as amended in the amended claims 1, 3, and 5-6, the sensing circuit includes the control transistor (2) and the detecting resistor (R2) and is coupled in series with each other, but the sensing circuit is coupled in parallel to the driving circuit, i.e., the first transistor (11), such that the current going through the driving transistor (11) and the load (RL) does not have to go through the sensing circuit (2, R2), and such that the sensing circuit (2, R2) consumes tiny electric power because the control transistor (2) takes tiny current for the sensing circuit (2, R2).

In addition, in the present invention, the control transistor (2) is a current mirror of the driving transistor (11) and may have a size much smaller than the driving transistor (11), and the size ratio can be smaller than one thousandth (1/1000), which results in a high power efficiency of 99.9%, or a power loss of 0.1%. Accordingly, when the driving transistor (11) is turned on to drive the load (RL), the control transistor (2) may be turned on to drive the detecting resistor (R2) with much smaller current, such that the detecting resistor (R2) may be in the range of 1k to few 10k ohms and may thus consume tiny electric power. It also makes detecting resistor of 1k ohms or 10k ohms feasible in an integrated circuit.

For claims 2 and 3, the Examiner further cites Sasahara et al. as an example disclosing a switching unit which includes a first

transistor N1 coupled to a first input terminal of a comparator to obtain one of the input signals, and a second transistor p5 coupled to a control transistor p4 to obtain the other input signal.

However, in Sasahara et al., as shown in FIG. 1, the mos p3 is not a switch, but operates as a linear mos and is part of the linear negative feedback circuit to maintain a constant Vinit for the second voltage range as shown in FIG. 2, such that Sasahara et al. uses a reference voltage, and the mos p3 operates as a linear mos but not a switch.

When comparator C1 detects a higher voltage at Va than VREF, the comparator C1 will turn on mos p4 and p5, such that the mos p4 and p5 are not part of sensing or detecting circuit. It is the comparator C1 which sends signals to the mos p4 and p5, and it detects a power supply voltage VEXT instead of detecting an over current situation.

For claim 7, the Examiner cites Gonthier et al. as an example of a short circuit detecting and protecting circuit comprising a switching unit including a first and a second switching transistors T1, T2, for obtaining first and second input signals respectively, a first and a second comparators 37, 39 each including a first and a second input terminals 40, 38, 36, 43 and an output terminal, said first input terminal of said first comparator being coupled to said first control transistor 32 via a first resistor 41, said second input terminal of said second comparator 39 being coupled to said second control transistor 33 via a second resistor 44, and a first detecting resistor 45 coupled between said first input terminal 40 of said first comparator 37 and said second input terminal 43 of

said second comparator 39, to actuate either said first or said second comparator to output control signals.

However, the Examiner has noted that Gonthier does not disclose a second detecting resistor in Figure 3, but disclose an alternative with voltage dividers to each input terminal 40 and 43 respectively.

In addition, the Examiner has also noted that Gonthier fails to disclose a first and a second control transistors. It would have been obvious to those skilled in the art at the time the invention was made to provide a first and a second control transistors coupled to said first and said second transistors of said switching unit respectively to control the time of the input signals to increase flexibility of the response over current events.

However, in Gonthier, as shown in FIG. 3, the transistors T1, T2 of the two one-way switches are coupled in parallel to each other, the bidirectional switch or sensing circuit 22 is coupled in series with the load (LOAD), such that the current go through the LOAD has to flow through the bidirectional switch or sensing circuit 22, i.e., the bidirectional switch or sensing circuit 22 consumes some portion of the electric power when the LOAD is being driven, and such that the power efficiency is reduced.

The voltage across a forward or high current diode is about 0.8~1.0v, and the saturation voltage across a transistor is around 0.2~0.3v. The total loss is about 1v times the current flowing through the LOAD. If the power supply is 10v, then the total loss is 1/11 or about 9.1%.

By contrast, in Applicant's invention, as amended in the

amended claims 1, 3, and 5-6, the control transistor (2) and the detecting resistor (R2) are coupled in series with each other, but are coupled in parallel to the driving transistor (11) and the load (RL), such that the current goes through the driving transistor (11) and the load (RL) does not have to go through the control transistor (2) and the detecting resistor (R2), and such that the control transistor (2) and the detecting resistor (R2) consume tiny electric power because the control transistor (2) takes tiny current for the detecting resistor (R2).

In the present invention, no reference voltage is used, and the control transistor (2) is acted as a switch for providing sense current/voltage to the comparator (3), such that the control transistor (2) is part of a sensing circuit, and it is the sensing circuit which sends signals to the comparator (3). The circuit of the present invention is provided for detecting an abnormal load (RL) or an over current situation, instead of detecting a power supply voltage.

The cited arts fail to teach a control transistor (2) coupled between a switching unit (1) and a comparator (3) to detect the flowing of the input signals to the comparator (3), a first transistor (11) coupled to the comparator (3) to obtain one of the input signals, and a second transistor (12) coupled to the control transistor (2) to obtain the other input signal, and simultaneously a detecting resistor (R2) coupled for detecting a voltage difference between the input terminals of the comparator (3) for allowing the comparator (3) to determine a short-circuit or overload situation.

The cited arts also fail to teach a control transistor (2) and a

detecting resistor (R2) coupled in series with each other and coupled in parallel to a driving transistor (11) and a load (RL), for preventing the current that goes through the driving transistor (11) and the load (RL) from going through the control transistor (2) and the detecting resistor (R2), and for allowing a tiny current to flow through the control transistor (2) and the detecting resistor (R2). The applicant's invention is different from that of the cited arts and has improved over the cited arts.

In view of the foregoing amendments and remarks, applicant respectfully submits that the present invention is patentably distinguishable over the cited arts and that the application is now in condition for allowance, and such action is earnestly solicited.

Courtesy and cooperation of Examiner THOMAS are appreciated.

respectfully submitted,

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